Acoustic Emission Based Assessment of Temporomandibular Joints

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Purpose

The prevalence of temporomandibular joint (TMJ) disorders is between 5% and 12% [1]. Diagnosis and treatment are challenging. Currently, radiographic [i.e. magnetic resonance imaging (MRI)] studies of the TMJ are necessary for a diagnosis. This is often time consuming, expensive, and may not show involvement until the disease is advanced. A method to quantitatively and objectively diagnose and monitor the TMJ is necessary. We developed a novel TMJ sound recording device that measures TMJ acoustic emissions (AEs) produced during jaw movement. The purpose of this project was to investigate the use of this device to measure AEs of TMJs.

Materials and Methods

In this study (IRB#00081670), we enrolled children who visited the Oral and Maxillofacial Surgery Clinic for any reason. Subjects were divided into 2 groups (healthy controls and sounds). An oral and maxillofacial surgeon (OMS) performed thorough TMJ examination to observe the presence of TMJ sounds during maximal incisal opening (MIO) and lateral excursions. Subjects wore a custom-built headset with two uniaxial Dytran accelerometers attached over bilateral TMJs which measured the TMJ sounds. Each subject wore the headset while performing 10 open/close (OC, i.e. MIO) and 10 medial/lateral (ML i.e. lateral excursions) jaw motions. During these motions, the device recorded the AEs produced by the TMJs. These AEs were processed and assessed in terms of signal heterogeneity.

The b-value was calculated for the signals. The b-value is the slope of a linear regression of the ordered peaks of a signal. A more heterogenous signal with more peaks has a lower b-value. Therefore, we postulate that the more chaotic signals of patients with TMJ sounds will have a lower b-value than those of healthy controls. In addition, a one-tailed, unmatched t-test was used to describe statistical differences between the b-value means of the healthy control and sounds groups. Significance was indicated as $p < 0.05$.

Results

The study was conducted on 33 subjects (7 males and 26 females, between the ages of 7-18 with an average of 13.1 ± 2.8 years old), 10 of whom had self-reported TMJ sounds. Presence of TMJ sounds was verified by OMS. The AEs of healthy patients were considerably less heterogenous than those of the patients with TMJ sounds. This is indicative of a smoother articulation with less intra-joint friction [2]. The t-tests for both the OC and ML exercises were significant (p= 0.01, 0.00014, respectively).

Conclusion

In this group, TMJ AEs provided reliable, quantitative information that reflected the clinical assessment. Further refinement of this technique could enable it to serve as a screening tool for patients with TMJ diseases.

References

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